Postoperative pain after posterior lumbar interbody fusion: is it worth it?

Ahmed S. Barakat

Department of Orthopedics and Traumatology, Cairo University, Cairo, Egypt

Correspondence to Ahmed S. Barakat, MD, Department of Orthopedics and Traumatology, Faculty of Medicine, Cairo University, Cairo, Egypt Tel: +20 152 2652 9829; e-mail: ahmedsamir222222@live.com

Received: 14 May 2017
Revised: 18 June 2017
Accepted: 1 July 2017
Published: 6 August 2021

The Egyptian Orthopaedic Journal 2020, 55:159–164

Introduction
Posterior lumbar interbody fusion (PLIF) is a widely accepted procedure for many lumbar degenerative disorders. However, it has been suspected for causing significant postoperative pain in the first few months.
Patients and methods
This prospective study included 36 consecutive patients who underwent a single-level PLIF procedure and were followed up for at least 1 year. At one-year follow-up, there were 20 females and 16 males, with an average age of 60.7 y (range: 39–81 y). All patients were operated in a standardized fashion, with bone graft taken from the iliac crest. Postoperatively, all patients received a standardized analgesic regimen. The modified Oswestry disability index (ODI) and visual analog score (VAS) were assessed preoperatively, at 3 months, at 6 months, and at 1 year postoperatively. Patients who had an obvious surgical reason for postoperative pain such as pedicular screw misplacement, postoperative hematoma, infection, wound problems, loose osseous fragment impingement on neural structures and postoperative pedicle, vertebral body, endplate fracture, or sacroiliac joint violation were excluded from the study.
Results
The most common indication for PLIF was lumbar stenosis with instability (n=18) and at 1-year follow-up, all 36 patients achieved bony intervertebral body fusion. The average preoperative ODI was 67.33% (range: 56–82%), and the mean preoperative VAS was 7 (range: 5–9). At 3 months, there was a significant improvement in relation to the preoperative ODI and VAS (P less than 0.0001 for both). Yet, at 6 months and at one year, there was a significant improvement when compared with the preoperative ODI and VAS ($P<0.0001$ for both). The largest improvement of ODI occurred between the third and sixth postoperative month (13%), whereas the largest improvement of VAS occurred between the sixth and 12th postoperative month (2.13). The most common source of pain was the iliac crest graft but tended to resolve completely at 1 year postoperatively. Four (11.11%) patients had slight to moderate pain after one year at the iliac crest. Three patients (8.33%) had persistent slight to moderate low back pain.
Conclusion
For many patients, PLIF is a painful experience, and strict adherence to the details of the operation are necessary to optimize the overall outcome. Still, the iliac crest graft is a major source of postoperative pain, although there is a significant overall improvement of the ODI and VAS at 1 year, and most patients report that they benefited from this operation. This series is based only on a single-center experience, and hence larger multicentric studies are needed to produce reliable data. Confounding this small series is individual pain perception and the inherent subjectivity of the ODI and the VAS.

Keywords:
iliac crest graft, Oswestry disability index, posterior lumbar interbody fusion, postoperative pain, visual analog scale

Egypt Orthop J 55:159–164

1110-1148

Introduction

Briggs and Milligan [1] first described their technique by using laminectomy bone fragments as an intervertebral graft for posterior lumbar interbody fusion (PLIF). In 1953, Cloward [2] marked the advent of contemporary lumbar fusion surgery by his technique of using iliac crest graft, which was associated with higher fusion rates. This led to a drastic surge of lumbar fusion operations within the past 2 decades in the USA [3]. The availability of fusion cages, allograft, and synthetic bone substitutes and better instrumentation further added to this trend [4]. Dorsal stabilization by pedicular screws improved

the fusion rate as reported by Steffee *et al*. [5], whereas others added a posterolateral fusion to the PLIF to obtain a true 360° intervertebral fusion [6].

Primary indications for PLIF include spondylolisthesis, spinal instability, spinal stenosis, and degenerative *de-novo* scoliosis, as well as chronic low back pain and recurrent radiculopathy [2]. Other indications comprise recurrent lateral or massive disc herniation, discogenic low back pain, recurrent lumbar disc prolapse, and failed prior lumbar fusions attempted by other procedures [7].

Surgery-related postoperative pain may be caused by screw misplacement, iatrogenic neurological injury, loose fragments with neurological compromise, osseous fracture of the pedicle, vertebral body or endplates, infection, or wound healing issues.

Postoperative posterior iliac graft morbidity has previously been described as a common source of persistent postoperative pain [8,9].

Nevertheless, most PLIF patients report postoperative pain that resolves after a various amount of time without identifying a relevant cause despite undergoing thorough diagnostics.

This work shows the pain course of 36 patients within one year who underwent PLIF surgery while considering only patients with nonsurgery-related postoperative pain.

Patients and methods

This prospective study included 36 consecutive patients who underwent a single-level PLIF procedure who were followed up for at least 1 year. None of the patients had prior low back surgery. There were 20 females and 16 males, with an average age of 60.7 years (range: 39–81 years), and they were followed up for 1 year. They were operated in a standardized fashion on a rectangular polster with bone grafting from the iliac crest. Only the outer table was osteotomized to obtain good cancellous bone while strictly avoiding any sacroiliac violation. Two Harms titanium cages (DEPUY SPINE Inc., Raynham, Massachusetts, USA) were used and filled with iliac crest autograft. No osteoinductive substances were used. Postoperatively, all patients received a standardized analgesic regiment comprising ibuprofen 600 mg tds, novalgin 1 g IV tds, and hydromorphone 4 mg tds for 5 days. Continuous analgesic infusions or patient-controlled analgesic perfusors were not used. All patients were discharged on the seventh postoperative day, and a standardized physiotherapy protocol was initiated on the first postoperative day. The adapted Arabic Oswestry disability index (ODI) [10] and visual analog score (VAS) [11] were collected preoperatively, at 3 months, at 6 months, and at 1 year postoperatively. Outcome data were analyzed on an intention-to-treat basis. Patients who had an obvious surgical reason for postoperative pain such as pedicular screw misplacement, postoperative hematoma, infection, wound problems, inadvertent compression on neural structures by loose bony fragments and postoperative pedicle, vertebral body, endplate fracture, or sacroiliac joint violation were excluded from the study. Likewise, we would subsequently exclude any patient with postoperative occurring neurological injury, to be able to attribute the postoperative pain only to the natural history of postoperative PLIF pain and not to iatrogenic neural damage.

All patients signed a written consent after having been informed in detail about the surgery and its inherent complications. An Ethical Board Committee permission was not necessary, as the PLIF technique is a well-established treatment modality routinely used in our facility for almost 20 years.

Statistical analyzes were conducted with SPSS 19.0 (IBM, Chicago, Illinois, USA) and comprised paired *t*-test analyzes of the ODI and VAS, with a confidence interval of 95% and significance set at P less than 0.05.

Results

At 1 year, all 36 patients showed radiological signs of bony fusion. The most common level fused was L4/5 (14 patients, 38.88%), and the second most common level was L3/4 (10 patients, 27.77%). None of these patients showed signs of postoperative root or dural injury during the follow-up period. The most common indication for single-level PLIF was spinal canal stenosis with (micro-) instability found in 18 patients (50%), with 11 patients (30.55%) with spondylolisthesis as the second most common indication. We identified at 1-year follow-up four patients (11.11%) with persistent low to moderate iliac crest pain originating from the bone graft site. Three patients (8.33%) had persistent slight to moderate low back pain 1 year postoperatively not involving the iliac crest. However, all three stated that this pain was tolerable and much more tolerable when compared with the preoperative pain status, requiring no regular NSAID intake.

When comparing the patient-reported ODI and VAS, there was a respective significant decrease of both subjective measures (Figs. 1,2) between each measure. The mean difference between the preoperative ODI and the ODI at 3 months changed from 67.33 to 59%. At 6 and 12 months postoperatively, the mean ODI reached 46 and 32%, respectively. The highest fall in mean ODI was therefore between the sixth and 12th postoperative month (14%). The lowest decrease was inbetween the preoperative and the ODI at 3 months and was 8.33%. Nevertheless, the decline in all measures was significant, as *P* was less than 0.0001 between each pair (Tables 1 and 2).

Table 1 ODI sample means

	Mean	*N*	SD	SEM
Pair 1				
Preoperative ODI	67.33	36	7.171	1.195
3-month ODI	59.00	36	6.599	1.100
Pair 2				
Preoperative ODI	67.33	36	7.171	1.195
6-month ODI	46.00	36	7.971	1.329
Pair 3				
Preoperative ODI	67.33	36	7.171	1.195
12-month ODI	32.00	36	6.029	1.005
Pair 4				
3-month ODI	59.00	36	6.599	1.100
6-month ODI	46.00	36	7.971	1.329
Pair 5				
6-month ODI	46.00	36	7.971	1.329
12-month ODI	32.00	36	6.029	1.005
Pair 6				
3-month ODI	59.00	36	6.599	1.100
12-month ODI	32.00	36	6.029	1.005

ODI, Oswestry disability index.

The same *P* less than 0.0001 was identified for VAS between all measurements. However, the largest fall of VAS occurred between the third and sixth postoperative month (2.139). Again, the smallest fall occurred between the preoperative VAS and the third postoperative month (1.056) (Tables 3 and 4).

We believe that between the third and sixth postoperative month, the bony consolidation had sufficiently progressed to stabilize the two adjacent vertebrae and prevent micromotion. Both ODI and VAS showed a linear regression depicted by the trendline in Figures 1 and 2.

Discussion

Although being technically more demanding, PLIF has been proclaimed as a superior and biomechanically sounder lumbar fusion technique, providing a higher fusion rate when compared with the other techniques. It requires thorough hemostasis, substantial bone resection, and cautious nerve root retraction [12,13]. The latter may lead to neural injury, whereas undue bleeding hinders visualization, jeopardizing neural structures, and may even cause epidural fibrosis. Therefore, some authors prefer a unilateral approach to the disc through the neuroforamen (transforaminal TLIF), thus reducing neural injury [14].

DeVine *et al.* [15] strongly recommended administering both a VAS for pain and a condition-specific physical measure such as the ODI presurgically and postsurgically, as these outcomes are the most treatment specific and reactive to alteration.

Table 2 Paired *t*-test analysis of the ODI showing the strong significance for all six pairs (highlighted grey)

	Paired samples test							
	Paired differences							
				95% Confidence interval of the difference				
	Mean	SD	SEM	Lower	Upper	*t*	*df*	Significance (2-tailed)
Pair 1								
Preoperative ODI – 3-month ODI	8.333	5.727	0.955	6.396	10.271	8.730	35	0.000
Pair 2								
Preoperative ODI – 6-month ODI	21.333	7.589	1.265	18.765	23.901	16.865	35	0.000
Pair 3								
Preoperative ODI – 12-month ODI	35.333	7.075	1.179	32.939	37.727	29.964	35	0.000
Pair 4								
3 months ODI – 6-month ODI	13.000	5.865	0.978	11.016	14.984	13.299	35	0.000
Pair 5								
6 months ODI – 12-month ODI	14.000	7.282	1.214	11.536	16.464	11.535	35	0.000
Pair 6								
3-month ODI – 12-month ODI	27.000	6.599	1.100	24.767	29.233	24.550	35	0.000

ODI, Oswestry disability index.

Still disputed is the clinically significant difference indicating clinical improvement in the ODI from start to end point, as Meade *et al.* [16] stated a minimum ODI difference of four and Taylor *et al.* [17] proposed a mean difference of 18.

Enker et Steffee reported fusion rates of up to 96%, and clinical success might reach 86% [13]. After 5 years of follow-up, Freeman and colleagues reported an 83% success rate in 60 patients [6]. Similar data were reported for the TLIF technique [16,17]. Fusion was achieved in 100% when reviewing our 36 patients after 12 months.

Table 3 VAS sample means

Paired samples statistics				
	Mean	*N*	SD	SEM
Pair 1				
Preoperative VAS	7.06	36	1.194	0.199
3-month VAS	6.00	36	1.146	0.191
Pair 2				
Preoperative VAS	7.06	36	1.194	0.199
6-month VAS	3.86	36	1.477	0.246
Pair 3				
Preoperative VAS	7.06	36	1.194	0.199
12-month VAS	2.67	36	1.146	0.191
Pair 4				
3-month VAS	6.00	36	1.146	0.191
6-month VAS	3.86	36	1.477	0.246
Pair 5				
3-month VAS	6.00	36	1.146	0.191
12-month VAS	2.67	36	1.146	0.191
Pair 6				
6-month VAS	3.86	36	1.477	0.246
12-month VAS	2.67	36	1.146	0.191

VAS, visual analog scale,

Ibrahim *et al.* [18] in their meta-analysis spanning 634 patients examining surgical versus non-surgical treatment of chronic low back pain found the pooled mean difference in ODI between the surgical and non-surgical groups to be in favor of surgery (mean difference of ODI: 4.13, 95% confidence interval: −0.82 to 9.08, P=0.10, I^2=44.4%).

Madan and Boeree reported the clinical satisfactory outcome of 44 patients with spondylolytic spondylolisthesis treated by either standalone posterolateral fusion (21 patients) or circumferential fusion involving PLIF and posterolateral fusion (23 patients). The reported satisfactory outcome reported as Oswestry index was 81% for posterolateral fusion and 69% for PLIF [19]. We report a steady decline within the first postoperative year of the ODI and VAS correspondingly, and only three patients (8.33%) had slight to moderate pain after 1 year, not requiring regular NSAID intake.

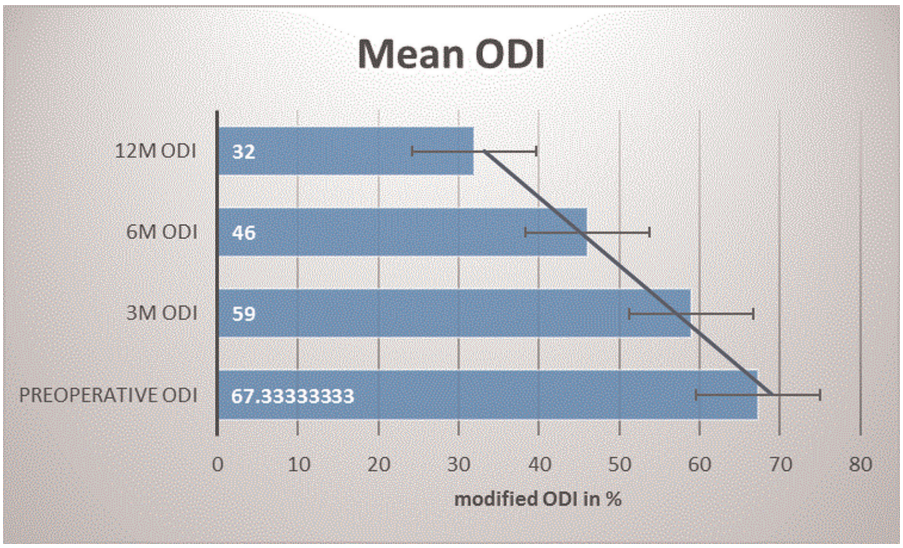
Conjoined activation of various pain mechanisms as nociceptive, neuropathic, and inflammatory may produce postoperative pain [20]. This is further compounded by already preexisting preoperative chronic pain, leading to increased pain perception and higher needs for analgesics [21]. Spinal pain may originate from the discs, ligamentous structures, facet joints, adjacent muscles and fascia, dura, nerve roots, and vertebrae and is transmitted via the posterior

Table 4 Paired *t*-test analysis of the VAS showing the strong significance for all six pairs (highlighted grey)

Paired samples test								
	Paired differences							
				95% Confidence interval of the difference				
	Mean	SD	SE	Lower	Upper	*t*	*df*	Significance (2-tailed)
Pair 1								
Preoperative VAS – 3-month VAS	1.056	1.170	0.195	0.660	1.451	5.414	35	0.000
Pair 2								
Preoperative VAS – 6-month VAS	3.194	1.451	0.242	2.704	3.685	13.214	35	0.000
Pair 3								
Preoperative VAS – 12-month VAS	4.389	1.517	0.253	3.876	4.902	17.358	35	0.000
Pair 4								
3-month VAS – 6-month VAS	2.139	1.268	0.211	1.710	2.568	10.118	35	0.000
Pair 5								
3-month VAS – 12-month VAS	3.333	1.242	0.207	2.913	3.754	16.102	35	0.000
Pair 6								
6-month VAS – 12-month VAS	1.194	1.451	0.242	0.704	1.685	4.941	35	0.000

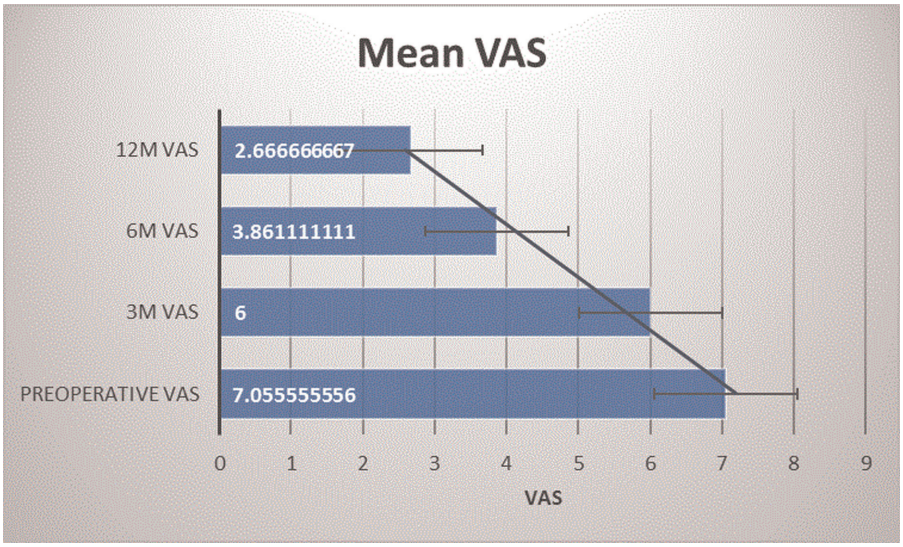
VAS, visual analog scale.

Figure 1



Mean modified Oswestry disability index preoperatively, at 3 months, at 6 months, and at 12 months.

Figure 2



Mean visual analog score preoperatively, at 3 months, at 6 months, and at 12 months.

rami of spinal nerves. The referred pain, which predominantly presents in patients with preexisting chronic pain, occurs commonly because of extensive cross-linking. On the contrary, the pain in the postoperative phase tends to be more localized and temporary with a tendency to show steady improvement [22]. Furthermore, the extent of spine surgery is related to the magnitude of the postoperative pain [23].

Robertson and Wray examined the natural history of iliac bone grafting in 106 patients for 1 year and identified donor site pain as a major source of morbidity. A localized loss of sensation was found in 10 and 55% of their patients had no iliac pain 1 year postoperatively. They report that the highest mean VAS was found at 6 months, the lowest at 12 months and that there was a correlation between iliac crest morbidity and the spinal levels subjected to surgery, being highest in the lumbosacral region [24].

In our series, persistent low to moderate iliac pain extending for more than 1 year was found in 4 patients (11.11%), which coincidences with the findings of Robertson and Wray. Contradicting to them, we found that 32 patients (88.88%) had no pain at the iliac crest at 6 months, which might be explained by the small approach and amount of bone

harvested for a single-level PLIF. Although allograft shows no donor site morbidity, it has been implicated in increased rates of pseudarthrosis and delayed union and a higher incidence of graft collapse [25].

Conclusion

For many patients, undergoing PLIF is a painful experience, and strict attention to the details of the operation is necessary to optimize the overall outcome. Still, the iliac crest graft is a major source of postoperative pain, although there is a significant overall improvement of the ODI and VAS at 1 year and most patients report that they benefited from this operation. Nevertheless, it is mandatory to advise the patient of possible postoperative pain related to the PLIF procedure and iliac crest grafting, which tends to decrease substantially within 1 year.

Our series is based on a single-center experience, and hence, larger multicentric studies are needed to report reliable data. Confounding this small series is individual pain perception and the inherent subjectivity of the ODI and the VAS.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Milligan P, Briggs H. Chip fusion of the low back following exploration of the spinal canal. J Bone Jt Surg 1944 26:125–130.

2 Cloward RB. The treatment of ruptured lumbar intervertebral discs by vertebral body fusion. J Neurosurg 1953; 10:154–168.

3 Resnick DK, Choudhri TF, Dailey AT, Groff MW, Khoo L, Matz PG, *et al.*, and American Association of Neurological Surgeons/Congress of Neurological Surgeons, Guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 8: lumbar fusion for disc herniation and radiculopathy. J Neurosurg Spine 2005; 2:673–678.

4 Ray CD. Threaded titanium cages for lumbar interbody fusions. Spine (Phila Pa 1976) 1997; 22:667–79–80.

5 Steffee AD, Sitkowski DJ. Posterior lumbar interbody fusion and plates. Clin Orthop Relat Res 1988; 227:99–102.

6 Freeman BJ, Licina P, Mehdian SH. Posterior lumbar interbody fusion combined with instrumented postero-lateral fusion: 5-year results in 60 patients. Eur Spine J 2000; 9:42–46.

7 Mummaneni PV, Haid RW, Rodts GE. Lumbar interbody fusion: state-of-the-art technical advances. Invited submission from the Joint Section Meeting on Disorders of the Spine and Peripheral Nerves, March 2004. J Neurosurg Spine 2004: 1:24–30.

8 Goulet JA, Senunas LE, DeSilva GL, Greenfield ML. Autogenous iliac crest bone graft. Complications and functional assessment. Clin Orthop Relat Res 1997; 339:76–81.

9 Fernyhough JC, Schimandle JJ, Weigel MC, Edwards CC, Levine AM. Chronic donor site pain complicating bone graft harvesting from the posterior iliac crest for spinal fusion. Spine (Phila Pa 1976) 1992; 17:1474–1480.

10 Guermazi M, Mezghani M, Ghroubi S, Elleuch M, Ould Sidi Med A, Poiraudeau S, *et al.* The Oswestry index for low back pain translated into Arabic and validated in a Arab population. Ann Readapt Med Phys 2005; 48:1–10.

11 Bijur Silver PE, Wendy S, Gallagher E, John E. Reliability of the visual analog scale for measurement of acute pain. Acad Emerg Med 2001; 8:1153–1157.

12 Brantigan JW, Steffee AD. A carbon fiber implant to aid interbody lumbar fusion. Two-year clinical results in the first 26 patients. Spine (Phila Pa 1976) 1993; 18:2106–2107.

13 Enker P, Steffee AD. Interbody fusion and instrumentation. Clin Orthop Relat Res 1994; 300:90–101.

14 Harms J, Stoltze D. The indications and principles of correction of post-traumatic deformities. Eur Spine J 1992; 1:142–151.

15 DeVine J, Norvell DC, Ecker E, Fourney DR, Vaccaro A, Wang J, *et al.* Evaluating the correlation and responsiveness of patient-reported pain with function and quality-of-life outcomes after spine surgery. Spine (Phila Pa 1976) 2011; 36:S69–S74.

16 Meade TW, Dyer S, Browne W, Townsend J, Frank AO. Low back pain of mechanical origin: randomised comparison of chiropractic and hospital outpatient treatment. BMJ 1990; 300:1431–1437.

17 Taylor SJ, Taylor AE, Foy MA, Fogg AJ. Responsiveness of common outcome measures for patients with low back pain. Spine (Phila Pa 1976) 1999; 24:1805–1812.

18 Ibrahim T, Tleyjeh IM, Gabbar O. Surgical versus non-surgical treatment of chronic low back pain: a meta-analysis of randomised trials. Int Orthop 2008; 32:107–113.

19 Madan S, Boeree NR. Outcome of posterior lumbar interbody fusion versus posterolateral fusion for spondylolytic spondylolisthesis. Spine (Phila Pa 1976) 2002; 27:1536–1542.

20 Mathiesen O, Dahl B, Thomsen BA, Kitter B, Sonne N, Dahl JB, Kehlet H. A comprehensive multimodal pain treatment reduces opioid consumption after multilevel spine surgery. Eur Spine J 2013; 22:2089–2096.

21 Loftus RW, Yeager MP, Clark JA, Brown JR, Abdu WA, Sengupta DK, Beach ML. Intraoperative ketamine reduces perioperative opiate consumption in opiate-dependent patients with chronic back pain undergoing back surgery. Anesthesiology 2010; 113:1.

22 Bajwa SJS, Haldar R. Pain management following spinal surgeries: an appraisal of the available options. J Craniovertebr Junction Spine 2015; 6:105–110.

23 Bernard JM, Surbled M, Lagarde D, Trennec A. Analgesia after surgery of the spine in adults and adolescents. Cah Anesthesiol 1995; 43:557–564.

24 Robertson PA, Wray AC. Natural history of posterior iliac crest bone graft donation for spinal surgery: a prospective analysis of morbidity. Spine (Phila Pa 1976) 2001; 26:1473–1476.

25 Brantigan JW, McAfee PC, Cunningham BW, Wang H, Orbegoso CM. Interbody lumbar fusion using a carbon fiber cage implant versus allograft bone. An investigational study in the Spanish goat. Spine (Phila Pa 1976) 1994; 19:1436–1444.